

The Oil palm

Plant, People and Challenges



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The oil palm



- ◆ *Arecaceae*
Arecoideae
Cocoseae
- ◆ Two cultivated species :
 - *Elaeis guineensis*
African origin
 - *Elaeis oleifera* (richer in unsaturated fatty acids; growth rate; disease resistance)
American origin
 - Interspecific hybrids and back crosses

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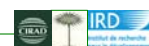
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Towards industrial plantations:

- After first World War : West Africa
- 1960 : Malaysia
- 1980 : Indonesia
- 1990 : Latin America



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A global commodity chain:

- ✓ >10 millions ha in the intertropical belt
- ✓ 1st world source of vegetable oil before soja
- ✓ 21.5 billions USD international business
- ✓ Importations EU-27 : 3.9 billions USD
- ✓ Importations China : 3.4 billions USD

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A STRATEGIC CROP FOR TROPICAL COUNTRIES

Major Vegetable Oil: World Supply (Million Metric Tons)

	2002/2003	2003/2004	2004/2005	2005/2006	2006/2007
Production					
Soybean	30.57	29.97	32.28	34.11	34.94
Palm	27.71	29.59	33.88	35.37	37.37
Sunflowerseed	8.12	9.13	9.01	10.11	10.10
Cottonseed	3.51	3.83	4.72	4.56	4.74
Coconut	3.16	3.29	3.44	3.54	3.26
Palm Kernel	3.36	3.67	4.13	4.31	4.48

Source : USDA-FAS 08-2006



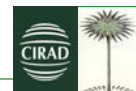
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A strictly tropical herb with two enemies:
drought and cold

- Soils : high adaptability to a wide range of pHs
- Latitude : 10° N / 10° S
- Altitude : < 500 metres
- Temperature : > 20° C
- Rainfall : > 1500 mm / yr with homogenous distribution
- Air Relative Humidity: > 70 %
- Sunshine: > 1800 hrs / yr

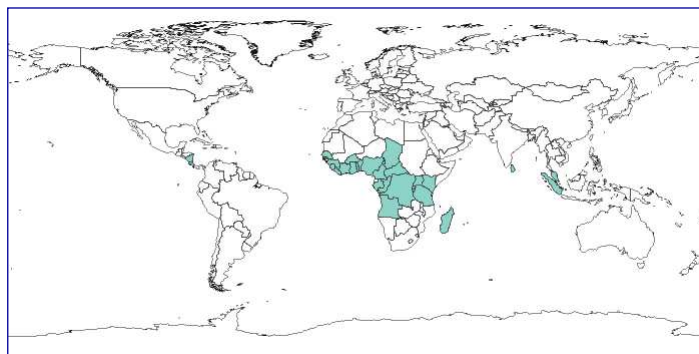


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Natural distribution of *E. guineensis*



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A strictly intertropical distribution

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Cultivated areas

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• Vegetative organs:

- ★ 1 stipe
- ★ 30 to 60 palms



★ Fasciculate root system

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• Reproductive organs

- ★ monoïcious, allogamous
- ★ Cross pollination
- ★ Male inflorescences : pollen



- ★ female inflorescences: bunches weighing 3 to 50 kg, bearing 300 to 3000 fruits
- ★ 27 months period between sex differentiation and bunch harvesting
- ★ 6 months period between flowering and harvest

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Genetic improvement



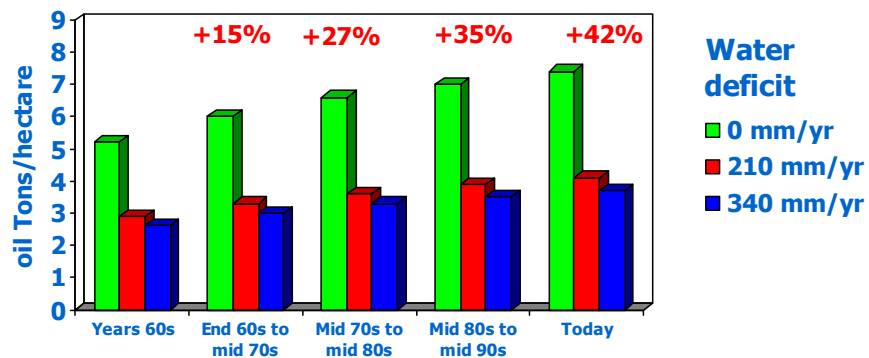
- ★ Genetic determinism of shell thickness: *dura/tenera/pisifera*
- ★ Intra-specific hybrids between cultivars from Asia (Deli) and Africa (LaMé, Yangambi)
- ★ Large scale production of selected seeds through assisted pollination
- ★ Genetic progress: + 40% since the 60's

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Genetic yield improvement



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Agronomical data

- Germination: (semi-orthodox seeds)
Breakage of inhibition: 4 months
including 80 days at 40°C
- Prenursery: 3-4 months (shaded area)
- Nursery: 8-9 months



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Agronomical data (intensive monoculture)

- Planting density: 143 palms/ha (9m equilateral triangle)
- Immature period : *ca* 3 yrs after planting
- Maximum productive period: from 6-8 years after planting
- Economical lifespan: 20 to 30 years



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Agronomical data (intensive monoculture)



- ★ Use of cover crop at young age (*Leguminosa*)
- ★ Manual weeding and/or herbicides : rounds, inter rows
- ★ Pruning
- ★ **Massive fertilisation:** N, P, K, Mg, B, ..., 1 - 2 or 3 times a year
(50% of running costs in mature plantations)
- ★ - Crop protection
 - Rodents
 - Leaf eating insects
 - Pathogens: *Fusarium*, *Ganoderma*, Bud Rot

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Harvesting (1)

- Continuous, all year long in optimal climatic conditions (if no dry season)
- Frequency : every 8 to 15 days, in each parcel
- Criterion of maturity: detached fruits



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Harvesting (2)

Manual harvesting of bunches

- ★ Eye spotting of mature bunches, manual cutting and collecting of bunches + detached fruits
- ★ 1 worker/15 ha



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Harvesting (3)

Transport to the mill
within 24 to 48 heures
and immediate
sterilisation



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Yield components

1. Bunch production :



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- The harvest is recorded in tons FFB: *Fresh Fruit Bunches*
- Adult plantation (>6years) : 8 to 35 tFFB/ha/yr
- Fluctuations in FFB yields on a yearly basis can be important, linked to climatic conditions (El Niño)

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Yield components

2. Palm oil productivity



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★ Extraction rates : % (**CPO** = *crude palm oil*) per fresh weight

★ Average ERs : **18 to 25 %** (depending on planting material, harvesting, mill, climatic conditions)

★ Palm Oil yields in tons CPO / ha, examples :

- $8 \text{ t FFB} \times 18 \% = 1.4 \text{ t CPO} / \text{ha} / \text{yr}$
- $30 \text{ t FFB} \times 25 \% = 7.5 \text{ t CPO} / \text{ha} / \text{yr}$
- *Intensive monoculture = 5 à 6 t CPO / ha / yr*

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Yield components

3. Kernel oil productivity

★ Kernel yield per FFB : **4-6 %**

★ Extraction Rates (PKO = *palm kernel oil*) : **50 %**

★ Yields in kernel oil / ha:

Examples (roughly **10 %** of CPO yields)

- $8 \text{ t FFB} \times 5 \% \times 50 \% = 0.2 \text{ t PKO} / \text{ha} / \text{an}$
- $30 \text{ t FFB} \times 5 \% \times 50 \% = 0.75 \text{ t PKO} / \text{ha} / \text{an}$



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Various different oil palm farming systems in the world

- **Traditional exploitation** of spontaneous oil palm groves: Nigeria, Congo, ...
- **Smallholders plantations (families)**, 1 to xxx ha:
 - Subdivisions of agro-industrial blocks *Malaysia, Indonesia*
 - Grouped around an industrial mill *Côte d'Ivoire, PNG*
 - Scattered with traditional extraction techniques *Western Africa*
- **Intensive agro industrial estates** of several thousands ha each : *Malaysia, Indonesia, PNG, Colombia, Ecuador, Peru, Côte d'Ivoire, Cameroon ...*



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- **Diversity of farming systems**

- Origin of planting material
- Level of intensification (density, fertilisation)
- Associated crops (mono/polyculture)



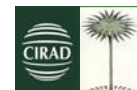
- **Diversity of technologies**

- Agro-industrial oil mills : 20 à 120 t FFB / hour
- mini-oil mills : several tons / hour
- micro-oil mills : several hundred kgs /hour



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The global context - 1



A stable international base :

- ◆ Distribution between smallholders and agro industrial groups (60/40)
- ◆ A **concentration** of 80% of world production in two countries: Indonesia and Malaysia,
- ◆ **Interdependence** with temperate oil crops
- ◆ A **constant popularity** among smallholders in all palm oil producing countries



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The global context - 2



Recent trends in palm oil prices:

- ◆ Very high rise in 2008 with combined effects of high demand and prospects for biofuels (high petrol prices)
- ◆ Sudden decrease linked with global economic crisis and drop in petrol prices



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	2003/04	2004/05	2005/06	2006/07
Production				
Indonesia	11,500	14,000	15,400	15,900
Malaysia	13,420	15,194	15,485	15,350
Thailand	840	700	755	850
Colombia	614	647	690	770
Nigeria	750	790	800	810
Other	2,432	2,544	2,681	2,697
Total	29,556	33,675	35,811	36,377
Imports				
China, Peoples Republic	3,710	4,363	4,975	4,900
EU-27	3,371	4,027	4,124	4,300
India	3,486	3,725	2,899	3,800
Pakistan	1,287	1,550	1,796	1,785
Bangladesh	326	797	847	900
Egypt	459	616	754	700
United States	231	345	600	630
Russian Federation	402	594	546	535
Turkey	336	439	462	510
Japan	450	492	494	500
Other	7,097	7,236	8,236	7,610
Total	21,417	24,144	25,733	26,250
Exports				
Malaysia	11,602	12,634	12,780	12,900
Indonesia	7,856	9,621	11,135	11,600
Papua New Guinea	347	362	360	360
Jordan	355	333	265	280
Colombia	188	222	213	225
Other	1,326	1,426	1,459	1,390
Total	21,674	24,598	26,212	26,755
Domestic Consumption				
China, Peoples Republic	3,710	4,363	4,975	4,900
Indonesia	3,779	4,015	4,361	4,540
EU-27	3,306	3,915	4,022	4,185
India	3,598	3,606	3,125	3,769
Malaysia	2,234	2,609	3,037	3,350
Pakistan	1,295	1,542	1,794	1,797
Nigeria	961	985	1,005	1,010
Bangladesh	540	747	821	925
Egypt	639	616	754	700
United States	234	322	567	636
Thailand	727	721	558	657
Colombia	449	437	491	525
Russian Federation	401	584	536	540
Turkey	335	439	462	510
Japan	451	492	499	505
Iran	353	351	362	380
Vietnam	183	193	285	350
Burma, Union of	224	278	304	330
Mexico	306	307	351	357
South Africa, Republic of	266	273	283	353
Other	5,299	5,834	6,441	6,252
Total	29,290	32,709	35,033	36,661
Ending Stocks				
Malaysia	1,318	1,527	1,941	1,341
Indonesia	650	1,023	938	708
EU-27	198	200	200	200
Pakistan	72	80	82	70
India	50	208	20	100
Other	370	332	488	461
Total	2,658	3,370	3,669	2,880

The global context - 3



- ◆ Oil palm is often targeted by environmentalists, as it is associated with deforestation, biodiversity reduction, pollution by mill effluents, land property and social conflicts.
- ◆ As oil palm is mainly used for human consumption, questions about food safety are arising (90% of oil palm is consumed in developing countries)



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Research at Cirad



- ⇒ *Smallholders: typology of players and strategies of innovation*
- ⇒ *Large scale supplying of improved planting material*
- ⇒ *Tackling major pathogens*
- ⇒ *Precision agriculture for sustainable plantations*

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Smallholders: Players & Innovations



- Changes in the commodity chain after massive privatisation in Ivory Coast. Emergence of cooperatives.(Cirad/Socodevi/Ird)



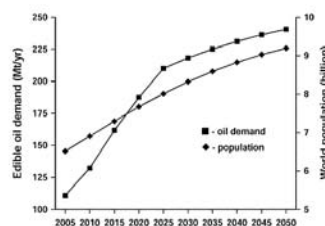
- Typology of smallholders and innovative farming systems in Cameroon (Cirad/Inra/Irad)

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Facing the global context ...



- ✓ The past 10 years have been characterised by:
 - a significant increase in demand for fat: + 50 %
 - a twofold increase in the production of oil palm and palm kernel, which now account for one third of total vegetable fat production.
- ✓ This trend is likely to continue over the next few years:
In addition to traditional uses for vegetable fat, there is a increase interest and forecasted demand for bio-fuels.



Source: 2006 World Population Prospects: The 2006 Revision

Facing the global context ...



- ✓ Meeting these demands will be extremely difficult, if not impossible, unless there is a considerable increase in oil palm production.



- ✓ The necessary increase in oil palm production will involve extending plantations but also improving yields.
- ✓ This will only be possible if planters can rely on quality seed

In order to achieve this goal, it is important to establish production centres for high quality seed, located in oil-producing regions

Large scale supplying of improved planting material



★ Breeding for improved yields

- International network for Recurrent Reciprocal Selection
- Integration of biotechnologies (mapping, QTLs,...)
- Markers Assisted Breeding

★ Commercial production of improved planting material. PalmElit

- Seed gardens under Cirad License
Benin, Côte d'Ivoire, Indonesia, Colombia, Ecuador, Thailand
- *In vitro* Micropropagation *Colombia*



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Tackling major pathogens



★ *Ganoderma* Project Indonesia, a partnership between Cirad, Socfindo and LonSum. *Epidemiology and nursery detection test*



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★ Breeding programs aimed at exploiting the natural tolerance to BudRot in *E. oleifera* in Latin America (Ecuador, Colombia)

★ Transfer of genetic progress into seed production: *F* Seeds tolerant to *fusarium* wilt (Nigeria, Cameroon), hybrid seeds (Colombia)

Precision agriculture for sustainable plantations



Towards a sustainable exploitation of intensive monoculture systems

- ★ Ecophysiology et models for reliable yields forecast
- ★ Innovative tools for precision agriculture
 - Modelling of mineral balance between plant and soil
 - ↳ rationalized used of chemical/organic manuring
 - Integration of remote sensing
 - ↳ Management of large oil palm areas
 - Recycling of Palm Oil Mill Effluents (POME)
 - ↳ Compliance with regulations
 - ↳ Composting



Challenges



- Oil palm and the Environment

- Extension of plantations: deforestation, conflicts for land property
- Agricultural Practices (« *zero burning* »)
- Carbon sequestration, GEG
- Pollutions :
 - Water tables, rivers by leaching of fertilizers
 - POME Effluents

- Oil Palm and food safety

- Quality Control
- Traceability of origins
- Organic palm oil (SIAT-Ghana)



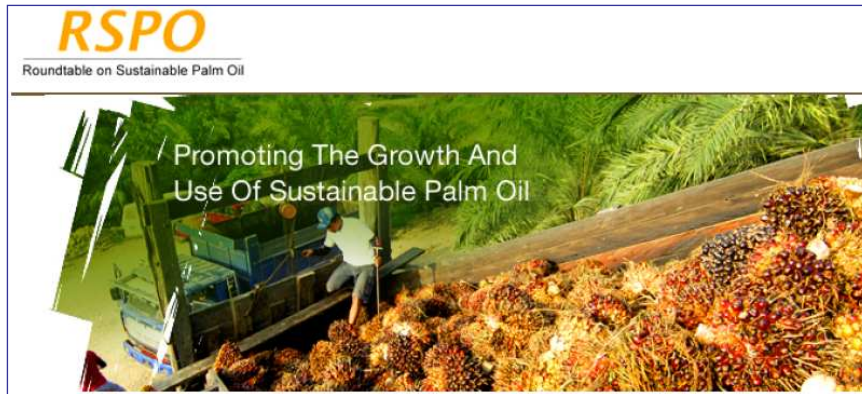
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Oil palm and sustainability challenges



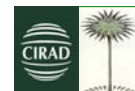
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Roundtable on Sustainable Palm Oil RSPO



A multi-stakeholder effort to form sustainable standards for palm oil production

Roundtable on Sustainable Palm Oil RSPO



In 2001, WWF gave an assignment to Reinier de Man, a Dutch consultant, to explore the possibilities for a Roundtable on Sustainable Palm Oil. The result was an informal co-operation among Aarhus United UK Ltd, Golden Hope Plantations Berhad, Migros, Malaysian Palm Oil Association, Sainsbury's and Unilever together with WWF in 2002.

The inaugural meeting of the [Roundtable](#) took place in Kuala Lumpur, Malaysia on 21 - 22 August 2003 and was attended by 200 participants from 16 countries. The key output from this meeting was the adoption of the [Statement of Intent \(SOI\)](#) which is a non-legally binding expression of support for the Roundtable process. As of 31 August 2004, [forty seven organisations](#) have signed the SOI.

On 8 April 2004, the "Roundtable on Sustainable Palm Oil (RSPO)," was formally established under Article 60 of the Swiss Civil Code with a governance structure that ensures fair representation of all stakeholders throughout the entire supply chain. The seat of the association is in Zurich, Switzerland, while the secretariat is currently based in Kuala Lumpur.

How much palm oil do we need?

R.H.V. Corley*

Highlands, New Road, Great Bedford, Bedford MK44 3LQ, UK

Consumer demand for sustainable palm oil has led to the formation of the RSPO, but to ensure that future development is directed away from forest land, governments, the palm oil industry and NGOs must all contribute:

- Biofuel subsidies from western governments ought to be better directed, to remove artificial incentives for oil palm expansion.
- Environmental NGOs in producer countries should develop maps identifying the most suitable land for oil palm expansion.
- Governments should then regulate development, but the industry must also collaborate directly with the NGOs, particularly where government is ineffective, to ensure that development is directed to suitable areas.
- Banks which finance oil palm projects should offer alternative types of finance for projects with no initial income from timber sales.
- Social NGOs can help to resolve land ownership disputes, but plantation companies should be open to new ideas regarding land ownership.

Review

Cell
PRESS

How will oil palm expansion affect biodiversity?

Emily B. Fitzherbert^{1,2}, Matthew J. Struebig³, Alexandra Morel⁴, Finn Danielsen⁵, Carsten A. Brühl⁶, Paul F. Donald⁷ and Ben Phalan⁸

Conclusions

For biodiversity, oil palm plantations are a poor substitute for native tropical forests. They support few species of conservation importance, and affect biodiversity in adjacent habitats through fragmentation, edge effects and pollution.

There is enough non-forested land suitable for plantation development to allow large increases in production without further deforestation, but political inertia, competing priorities and lack of capacity and understanding, not to mention high levels of demand for timber and palm oil from wealthy consumers, often make it cheaper and easier to clear forests.

The efforts of some producers to reduce their environmental impacts, especially by avoiding forest conversion, must be commended.

However, unless governments in producer countries become better at controlling logging, protecting forests and ensuring that crops are planted only in appropriate areas, the impacts of oil palm expansion on biodiversity will be substantial.

Estimation of the impact of oil palm plantation establishment on greenhouse gas balance

J. Germer · J. Sauerborn

The calculations of CO₂eq emissions caused and carbon sequestered in response to oil palm establishment clearly show the advantage of grassland rehabilitation over forest clearance.

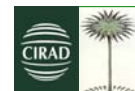
Regulations and incentives steering the expansion of the oil palm industry are thus potential tools to reduce emissions through prevention of new plantation establishment in forest areas, especially on organic soils.

In addition, promoting grassland rehabilitation for oil palm plantings could contribute to carbon sequestration. The 'United Nations Framework Convention on Climate Change' flexibility mechanism could offset additional costs for plantation establishment on grassland.

With global emission trading becoming a reality, emitters unable to meet their own targets could pay off through carbon sequestration in oil palm plantations. Currently the price for carbon dioxide emission credits traded on the European market is above 27 Euro per metric tonne (PointCarbon, 2006). At this price the rehabilitation of grassland through establishment of oil palm plantations would value above 4.000 Euro per hectare.



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Thank you for your kind attention

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